1412.65616

PATENT

CERTIFICATION OF FACSIMILE TRANSMISSION

To: Mr. Jon Lachel
Pre-Grant Publication Division
U.S. PATENT AND TRADEMARK OFFICE

PROCESSED BY PG PUB DIVISION JUL 16 2002

Applicant: Senarath et al.

Serial No.: 09/939,231

Filed: August 24, 2001

For: MULTIBEAM WIRELESS COMMUNICATIONS METHOD AND SYSTEM INCLUDING AN INTERFERENCEAVOIDANCE SCHEME IN WHICH THE AREA OF EACH TRANSMITTED BEAM IS DIVIDED INTO A PLURALITY OF SUB-AREAS

FACSIMILE NO.: (703) 305-8568

Number of pages including this Certification: 7

Description: **REQUEST FOR CORRECTED PATENT APPLICATION PUBLICATION TO BE DELIVERED DIRECTLY TO MR. JON LACHEL**

FROM: James K. Folker
GREER, BURNS & CRAIN, LTD.
Suite 2500
300 South Wacker Drive
Chicago, Illinois 60606
TELEPHONE NUMBER: (312) 360-0080
FAX NUMBER: (312) 360-9315

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James K. Folker

James K. Folker
Reg. No. 37,538

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Pub. No.: US 2002/0058514 A1

Pub. Date: May 16, 2002

I hereby certify that this correspondence is being facsimile transmitted to the United States Patent and Trademark Office (Fax No. (703) 305-8568) on this date.

7/16/02
Date

Registration No. 37,538

F-CLASS.WCM
Appr. February 20, 1998

Attorney for Applicant

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REQUEST FOR CORRECTED PATENT APPLICATION PUBLICATION

Assistant Commissioner for Patents
Washington, D.C. 20231

Attention: Pre-Grant Publication Division

Sir:

In accordance with 37 C.F.R. § 1.221(b), Applicants, through their attorneys, respectfully request that the above-identified Patent Application Publication be corrected.

It is the respectful opinion of the Applicants, through their attorneys, that the mistakes in concern hereto, are of a material nature to the patent application and were made through the actions of the United States Patent and Trademark Office and not the Applicants or their attorneys. Consequently, a fee to correct the published application should not be due by the Applicants.

Please correct the following mistakes, which have been circled on the attached pages, copied both from the published application and the original application as filed. First, on page 8, line 7 of the published application, claim 8 mistakenly says, "...if 2R1>R2 and r1>r4...". While, according to page 24 of the original application as filed, claim 8, line 6 says, "...if 2R1≥R2 and r1≥r4...". This mistake is material, because it changes a mathematical symbol in a condition in the claim and would, likewise, change the affect of the claim. Secondly, on page 10, line 43 of the published application, claim 32 says by mistake, "...signals transmitted during a first time period (Ti) are ...". Whereas, according to page 34 of the original application, claim 32, line 12 says, "...signals transmitted during a first time period (T1) are...". Again, this mistake is material, because it confuses the reference time period of (T1) with a time period having a different designation and, likewise, does not properly identify the first time period in the claim.

Respectfully submitted,
GREER, BURNS & CRAIN, LTD.

By James K. Folker

James K. Folker
Registration No. 37,538

July 16, 2002

300 South Wacker Drive
Suite 2500
Chicago, Illinois 60606
Telephone: 312.360.0080
Facsimile: 312.360.9315
Customer No. 24978

a rotation position based on the following criteria, wherein, for a given mobile, the best rates from all the beams that can be supported in said time slots T1, T2, T3, T4, T5 and T6 are, respectively, r1, r2, r3, r4, r5 and r6, and further wherein R1=max(r1, r4) and R2=max(r2, r3, r5, r6):

*

if $2R1>R2$ and $r1>r4$, then mobile unit is served in said sub-area $G1_1$, $\cancel{G1_2}$, $G1_3$ or $G1_4$;

if $2R1\geqq R2$ and $r1<r4$, then mobile unit is served in said sub-area $RG1_1$, $RG1_2$, $RG1_3$ or $RG1_4$;

if $2R1<R2$ and $\max(r2, r3)>\max(r5, r6)$ and $r2\geqq r3$, then mobile unit is served in said sub-area $G2_1$ or $G2_4$;

if $2R1<R2$ and $\max(r2, r3)>\max(r5, r6)$ and $r2<r3$, then mobile unit is served in said sub-area $G2_2$ or $G2_3$;

if $2R1<R2$ and $\max(r2, r3)\leqq\max(r5, r6)$ and $r5\geqq r6$, then mobile unit is served in said sub-area $RG2_1$ or $RG2_4$; and

if $2R1<R2$ and $\max(r2, r3)\leqq\max(r5, r6)$ and $r5<r6$, then mobile unit is served in said sub-area $RG2_2$ or $RG2_3$.

9. A wireless communications system comprising:

at least four beam formers arranged within a cellular communications network, said beam formers including a first beam former for transmitting a first beam (B1) into a first area and a second beam former for transmitting a second beam (B2) into a second beam area, where said second beam area is adjacent said first beam area, and a third beam former for transmitting a third beam (B3) into a third beam area and a fourth beam former for transmitting a fourth beam (B4) into a fourth beam area, where said fourth beam area is adjacent said third beam area;

a mobile switching center for controlling signals transmitted from said at least four beam formers, including sending coded signals along said beams B1, B2, B3 and B4 such that:

each of said first, second, third and fourth beam areas are effectively divided into at least two sub-areas such that said first beam area includes sub-areas $G1_1$ and $G2_1$, said second beam area includes sub-areas $G1_2$ and $G2_2$, said third beam area includes sub-areas $G1_3$ and $G2_3$, and said fourth beam area includes sub-areas $G1_4$ and $G2_4$; and

wherein a group of frequencies are assigned to all of said beam areas within a single cell;

further wherein said assigned group of frequencies is divided such that half of said assigned group of frequencies serve mobile units located within sub-areas $G1_1$, $G1_2$, $G1_3$ and $G1_4$, and the other half of said assigned group of frequencies serve mobile units located within sub-areas $G2_1$, $G2_2$, $G2_3$ and $G2_4$.

10. The wireless communications system according to claim 9, wherein:

the group of frequencies assigned to sub-areas $G2_1$, $G2_2$, $G2_3$ and $G2_4$ is again divided in half, with one sub-group of this group being assigned to sub-areas $G2_1$ and $G2_4$ and the other sub-group being assigned to sub-areas $G2_2$ and $G2_3$.

11. The wireless communications system according to claim 9,

said sub-area $G1_1$ begins near an apex of said first area and extends generally down a center of said first area, and said sub-area $G2_1$ is located outside of said sub-area $G1_1$; and

said sub-area $G1_2$ begins near an apex of said second area and extends generally down a center of said second area, and said sub-area $G2_2$ is located outside of said sub-area $G1_2$.

12. The wireless communications system according to claim 9, wherein

said beams B1, B2, B3 and B4 are each rotated by half of the average beamwidth of all of the beams, thereby creating new sub-areas $RG1_1$ and $RG2_1$ in said first beam area, new sub-areas $RG1_2$ and $RG2_2$ in said second beam area, new sub-areas $RG1_3$ and $RG2_3$ in said third beam area and new sub-areas $RG1_4$ and $RG2_4$ in said fourth beam area, so that each mobile now has the option of selecting from either the rotated beams or the original beams, giving rise to more directed beams for the mobiles, thereby increasing both coverage and overall throughput; and

further wherein each of said new sub-areas $RG1_1$, $RG2_1$, $RG1_2$, $RG2_2$, $RG1_3$, $RG2_3$, $RG1_4$ and $RG2_4$ are served by different frequencies than said sub-areas $G1_1$, $G2_1$, $G1_2$, $G2_2$, $G1_3$, $G2_3$, $G1_4$, and $G2_4$.

13. A method for reducing interference in a wireless system including at least two beam formers and a plurality of mobile units, the method comprising the steps of:

transmitting a first beam (B1) from a first beam former into a first area, defining two sub-areas within said first area as sub-area $G1_1$ and sub-area $G2_1$;

transmitting a second beam (B2) from a second beam former into a second area, defining two sub-areas within said second area as sub-area $G1_2$ and sub-area $G2_2$;

coding signals of said beams B1 and B2 for receipt by a particular mobile unit based upon whether the particular mobile unit is located within said sub-area $G1_1$, said sub-area $G2_1$, said sub-area $G1_2$ or said sub-area $G2_2$, such that:

during a first time period (T1), making simultaneous transmissions from both said first and second beam formers for receipt by mobile units located, respectively, within said sub-area $G1_1$, or within said sub-area $G1_2$;

during a second time period (T2), making transmissions from said first beam former for receipt by mobile units located within said sub-area $G2_1$; and

during a third time period (T3), making transmissions from said second beam former for receipt by mobile units located within said sub-area $G2_2$.

14. The method according to claim 13, wherein:

said first area is adjacent to said second area;

said sub-area $G1_1$ begins near an apex of said first area and extends generally down a center of said first area, and said sub-area $G2_1$ is located outside of said sub-area $G1_1$; and

6. The wireless communications system according to Claim 1, wherein said beams B1, B2, B3 and B4 are each rotated by a portion of their beamwidth that is approximately equal to 1/nth of the average beamwidth, where n is the total number of rotated positions for each beam, thereby creating new sub-areas, and further wherein said new sub-areas are served by time periods other than said first, second and third time periods.

7. The wireless communications system according to Claim 5, wherein:

during a fourth time period (T4), simultaneous transmissions are made for receipt by mobile units located within said sub-areas $RG1_1$, $RG1_2$, $RG1_3$ and $RG1_4$;

during a fifth time period (T5), transmissions are made for receipt by mobile units located within said sub-areas $RG2_1$ and $RG2_4$; and

during a sixth time period (T6), transmissions are made for receipt by mobile units located within said sub-areas $RG2_2$ and $RG2_3$.

8. The wireless communications system according to Claim 7, wherein each mobile unit is assigned to a beam and a rotation position based on the following criteria, wherein, for a given mobile, the best rates from all the beams that can be supported in said time slots T1, T2, T3, T4, T5 and T6 are, respectively, r1, r2, r3, r4, r5 and r6, and further wherein $R1 = \max(r1, r4)$ and $R2 = \max(r2, r3, r5, r6)$:

* if $2R1 \geq R2$ and $r1 \geq r4$, then mobile unit is served in said sub-area $G1_1$, $G1_2$, $G1_3$ or $G1_4$;

if $2R1 \geq R2$ and $r1 < r4$, then mobile unit is served in said sub-area $RG1_1$, $RG1_2$, $RG1_3$ or $RG1_4$;

if $2R1 < R2$ and $\max(r2, r3) > \max(r5, r6)$ and $r2 \geq r3$, then mobile unit is served in said sub-area $G2_1$ or $G2_4$;

each of said beam areas includes at least one non-overlapping sub-area and at least two overlapping sub-areas, further defined as a first overlapping sub-area and a second overlapping sub-area;

comparing the strength of each beam signal within a particular sub-area to determine whether a particular mobile unit is located within said non-overlapping sub-area, said first overlapping sub-area or said second overlapping sub-area.

26. The method according to claim 25, further comprising the steps of:

determining that a particular mobile unit is located within said non-overlapping sub-area if the strength of all beam signals but one are less than a threshold value Y1;

determining that a particular mobile unit is located within said first overlapping sub-area if the difference between signal strengths from adjacent beams is less than a threshold value Y2, and the signal strength of said two adjacent beams combined is greater than a threshold value Y3; and

determining that a particular mobile unit is located within said second overlapping sub-area if the difference between signal strengths from adjacent beams is less than said threshold value Y3.

27. The method according to claim 26, wherein said threshold values Y1, Y2 and Y3 are all different values from each other.

28. The method according to claim 23, further comprising the steps of:

effectively dividing each of said first, second, third and fourth beam areas into at least two sub-areas such that said first beam area includes sub-areas $G1_1$ and $G2_1$, said second beam area includes sub-areas $G1_2$ and $G2_2$, said third beam area includes sub-areas $G1_3$ and $G2_3$, and said fourth beam area includes sub-areas $G1_4$ and $G2_4$; and

assigning a group of frequencies to all of said beam areas within a single cell;

dividing said assigned group of frequencies such that half of said assigned group of frequencies serve mobile units located within sub-areas $G1_1$, $G1_2$, $G1_3$ and $G1_4$, and the other half of said assigned group of frequencies serve mobile units located within sub-areas $G2_1$, $G2_2$, $G2_3$ and $G2_4$.

29. The method according to claim 23, further comprising the steps of dividing the group of frequencies assigned to sub-areas $G2_1$, $G2_2$, $G2_3$ and $G2_4$ in half again, and assigning one sub-group of this group to sub-areas $G2_1$ and $G2_4$ and assigning the other sub-group to sub-areas $G2_2$ and $G2_3$.

30. A beam forming apparatus for use with a wireless communication system, said beamforming apparatus comprising:

means for transmitting a beam into a first area and for defining two sub-areas within said first area as sub-area G1 and sub-area G2;

means for coding signals of said beam for receipt by a particular mobile unit based upon whether the particular mobile unit is located within said sub-area G1 or said sub-area G2 such that:

during a first time period (T1), making transmissions from said beam former for receipt by mobile units located within said sub-area G1, and

during a second time period (T2), making transmissions from said first beam former for receipt by mobile units located within said sub-area G2.

31. The beam forming apparatus according to claim 30, wherein a mobile unit is assigned to one of said sub-areas G1 or G2 by:

measuring the carrier-to-interference ratio (C/I) for a mobile unit during a 4/4 cycle to define a first rate;

measuring the carrier-to-interference ratio (C/I) for a mobile unit during a 2/4 cycle to define a second rate; and

comparing said first rate to said second rate, and if said second rate is larger than twice said first rate, assigning said mobile unit to said sub-area G2, otherwise said mobile unit is assigned to said sub-area G1.

32. A system of signals for use in a wireless communications system including at least a first beam former and a second beam former and a plurality of mobile units, the signals comprising:

signals transmitted from the first beam former into a first area, where said first area is divided into at least two sub-areas defined as sub-area $G1_1$ and sub-area $G2_1$;

signals transmitted from the second beam former into a second area, where said second area is divided into at least two sub-areas defined as sub-area $G1_2$ and sub-area $G2_2$;

coding said signals from said first and second beam formers for receipt by a particular mobile unit based upon whether the particular mobile unit is located within said sub-area $G1_1$, said sub-area $G2_1$, said sub-area $G1_2$ or said sub-area $G2_2$, such that:

signals transmitted during a first time period (T1) are transmitted simultaneously from both said ~~first and~~ second beam formers for receipt by mobile units located, respectively, within said sub-area $G1_1$, or within said sub-area $G1_2$; *

signals transmitted during a second time period (T2) are transmitted from said first beam former for receipt by mobile units located within said sub-area $G2_1$; and

signals transmitted during a third time period (T3) are transmitted from said second beam former for receipt by mobile units located within said sub-area $G2_2$.

33. The system of signals according to claim 32, wherein:

said first area is adjacent to said second area;

said sub-area $G1_1$ begins near an apex of said first area and extends generally down a center of said first area, and said sub-area $G2_1$ is located outside of said sub-area $G1_1$; and

said sub-area $G1_2$ begins near an apex of said second area and extends generally down a center of said second area, and said sub-area $G2_2$ is located outside of said sub-area $G1_2$.

34. The system of signals according to claim 32, wherein said beams B1, B2, B3 and B4 are each rotated by a portion

signals transmitted from the second beam former into a second area, where said second area is divided into at least two sub-areas defined as sub-area $G1_2$ and sub-area $G2_2$;

coding said signals from said first and second beam formers for receipt by a particular mobile unit based upon whether the particular mobile unit is located within said sub-area $G1_1$, said sub-area $G2_1$, said sub-area $G1_2$ or said sub-area $G2_2$ such that:

signals transmitted during a first time period (T1) are transmitted simultaneously from both said first and second beam formers for receipt by mobile units located, respectively, within said sub-area $G1_1$, or within said sub-area $G1_2$;

signals transmitted during a second time period (T2) are transmitted from said first beam former for receipt by mobile units located within said sub-area $G2_1$; and

signals transmitted during a third time period (T3) are transmitted from said second beam former for receipt by mobile units located within said sub-area $G2_2$.

33. The system of signals according to Claim 32, wherein:

said first area is adjacent to said second area;

said sub-area $G1_1$ begins near an apex of said first area and extends generally down a center of said first area, and said sub-area $G2_1$ is located outside of said sub-area $G1_1$; and

said sub-area $G1_2$ begins near an apex of said second area and extends generally down a center of said second area, and said sub-area $G2_2$ is located outside of said sub-area $G1_2$.

34. The system of signals according to Claim 32, wherein said beams B1, B2, B3 and B4 are each rotated by a portion of their respective beamwidths, thereby